WELCOME TO THE DRONE AGE

Karen Risa Robbins
Washington Progress Group
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WHERE ARE WE GOING WITH THEM

HOW SOON WILL WE GET THERE

ALL GOOD…OR NOT

POSSIBILITIES RUN WILD

SERIOUSLY, BIG EXPECTATIONS ARE STARTING TO SEEM CREDIBLE

The Association for Unmanned Vehicle Systems International Prediction

Between 2015 and 2025:

The Legalization of Commercial Drones Will Create More Than $80 Billion in Economic Impact (revenue, job creation)

Precision Agriculture Will Provide The Biggest Piece of That Growth

MOST COMMON AG USES TODAY

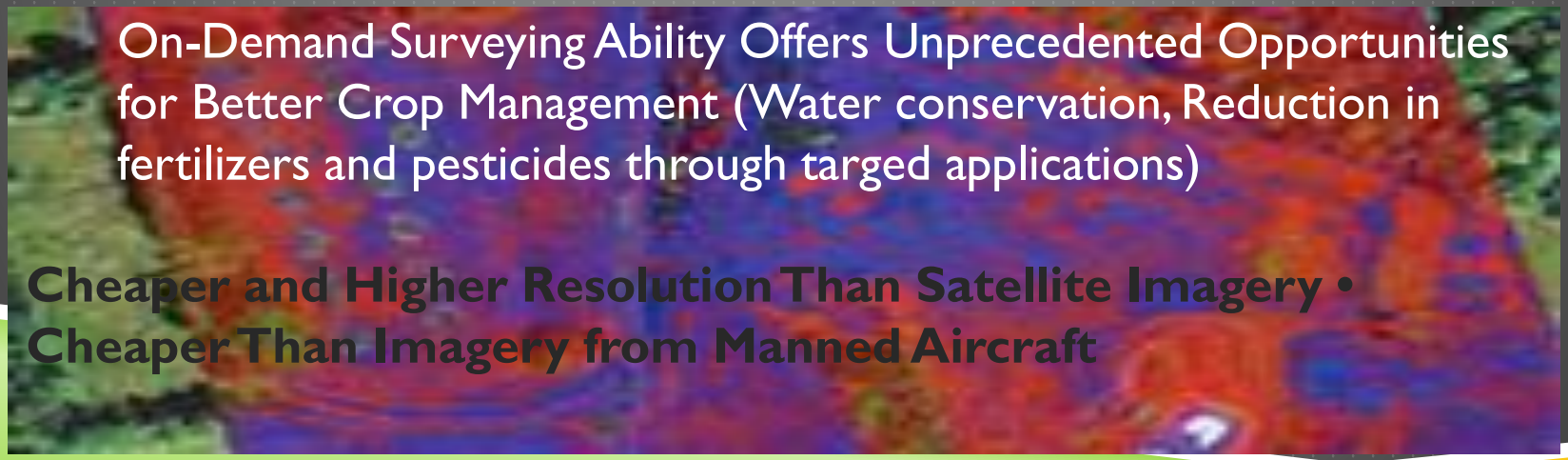
- Crop Health Monitoring
- Irrigation Equipment Monitoring
- Mid-Field Weed Identification
- Variable Rate Fertilizing
- Cattle Heard Monitoring

WELCOME BENEFITS

Low Altitude View Gives Farmers New Perspective

Reveals Patterns (Irrigation problems, Soil variation, Pest and Fungal infestations)

Airborne Multispectral Images Captures Infrared and Visual Spectrum Data, Highlighting Differences Between Healthy and Distressed Plants



On-Demand Surveying Ability Offers Unprecedented Opportunities for Better Crop Management (Water conservation, Reduction in fertilizers and pesticides through targed applications)

Cheaper and Higher Resolution Than Satellite Imagery • Cheaper Than Imagery from Manned Aircraft

DRONE BEGINNINGS

- WHAT DO YOU THINK SPURRED THE ORIGINAL ADVANCEMENT IN DRONES?
  - Military
  - Law Enforcement
  - Commercial
  - Environmental
  - Disaster Response

THE IMPETUS WAS ENVIRONMENTAL MONITORING

- 1989 DOD Gifts NASA Three Prototype Drones
  - **DOD Not Interested in Further Development!**

None Had Flown

They All Required A Lot More Work

- NASA Decides To Develop Them for Atmospheric Monitoring

DECADE OF INNOCENCE

- NASA's Environmental Research Aircraft and Sensor Technology (ERAST Program) 1989 – 2000
  - Matured the Predator Drone
  - Showed the Utility of Solar as Power Source for Long Duration Flight
- Focus on Atmospheric and Earth Science Applications
- No Military Involvement or Orientation
- No FAA Involvement or Attention to Regulatory Considerations

BOLD VS. ON-HOLD DECADE

THE BOLD PART

9/11 Happens and Military Embraces Drones

- Explosion in Defense Funding and Development
- Spectacular Deployments in Afghanistan and Iraq

THE ON-HOLD PART

FAA Apprehensive About Unmanned Technology

- FAA Says NO To All Commercial Drone Uses
- Severely Restricts Drone Operations by Public Entities
- Severely Restricts Civil Drone Flights, Except for Drone Testing

REGULATORY STALEMATE FOR COMMERCIAL AND CIVIL USES

- Drone Industry and Users Clamor for Standards
- FAA Says Standard is Equivalent Level of Safety to Manned Aircraft

EXACTLY HOW SAFE IS THAT MAN IN A MANNED AIRCRAFT?

Chicken/Egg Problem:

The Burden Is On The Drone That Wants to Fly (The Applicant) To Demonstrate Equivalent Level of Safety (ELOS). How Can The Applicant Demonstrate ELOS If The Standard is Not Quantified?

RULES DIFFERENT FOR PUBLIC AIRCRAFT

- Public Agencies and Organizations May Operate A Particular Aircraft, For A Particular Purpose, In a Particular Area
  - Public entities must obtain a Certificate of Authorization (COA) that allows an operator to use a defined block of airspace and includes special safety provisions unique to the proposed operation.
  - COAs usually are issued for a specific period – up to two years in many cases.
  - Applies to Federal, State, and Local Governmental Agencies
  - Applies to Public Universities

Common public uses today include law enforcement, firefighting, border patrol, disaster relief, and search and rescue.

CONGRESS GROWS IMPATIENT OVER COMMERCIAL STAGNATION

- In 2012 Congress Mandates FAA To Make Way for Commercial Drone Operations and To Integrate Drones by 2015
- In 2013, First Commercial Flights Approved in Arctic Through Cumbersome Process
- In 2014, FAA Offers Limited Exemption to Total Ban on Commercial Activities

KEYS TO THE GATED COMMUNITY

- THE SECTION 333 EXEMPTION IN 2014

Two-Step Approval Process

- Applies Only To Small Drones (under 55 lb fully loaded)
- Drone Must Be Registered with FAA (tail number
- Operator Must Be A Pilot (sport license OK)
- Operations Must Be Within Visual Sight of Pilot (unaided eyesight)
- Must Be During Daylight, in Clear Conditions
- Cannot Fly Above 500 Feet
- Fly Away From People and Airports

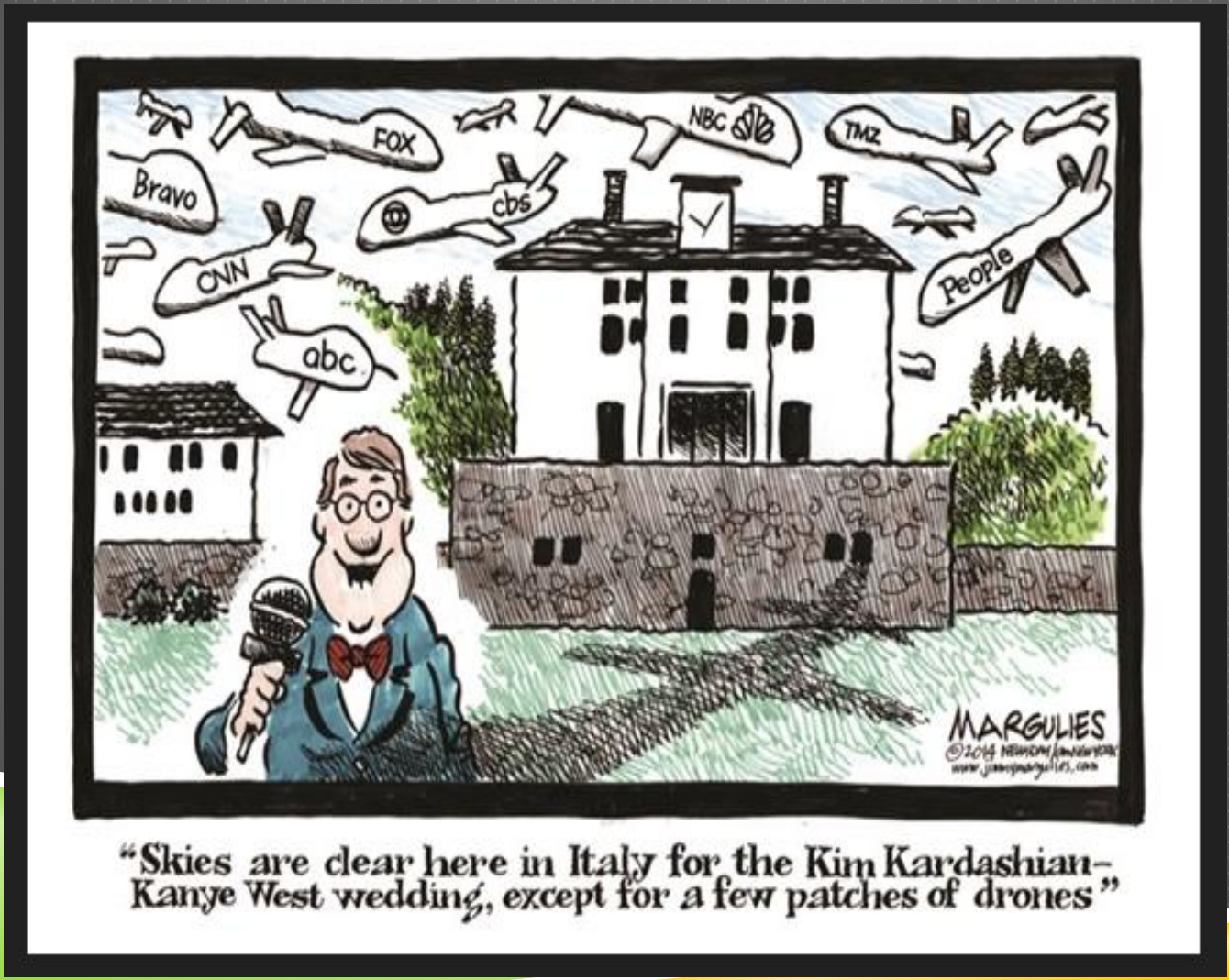
FASTPASS TO GATE OFFERED IN 2015

- SECTION 333 EXEMPTION GRANTED IN ONE-STEP PROCESS
- FASTER APPROVAL TIME (~60 days)

Same rules apply, but maximum flight altitude must remain below 200 feet

1000 COMMERCIAL FLIGHTS APPROVED BY JULY 2015

NOT QUITE YET



"Skies are clear here in Italy for the Kim Kardashian–Kanye West wedding, except for a few patches of drones"

EXEMPTION BREAKDOWN – JULY 2015

FAA UAS Exemptions by Industry*		
Industry	Number	Percent of Total Exemptions
Photo/Film	477	47.7%
Real Estate	289	28.9%
Utilities/Energy/Infrastructure	234	23.4%
Agriculture	202	20.2%
Construction	171	17.1%
Emergency Service	77	7.7%
Education	59	5.9%
Manufacturer	40	4.0%
Government Contracting	30	3.0%
Insurance	30	3.0%
Conservation	27	2.7%
Scientific Studies	18	1.8%
Other	15	1.5%

THE NEXT WAVE - NEXT YEAR

- FAA SAYS PERMANENT RULES FOR SMALL DRONES BY 2016
  - Probably no need to file for exemption in order to fly
  - Pilot will likely only need to pass written exam (no flight school)
  - Anticipate similar restrictions as today, i.e.,
    - Fly within visual line of sight of pilot
    - Daylight operations
    - Clear visibility
    - Low altitude

HEY DUDE

MINIMUM PILOT AGE MAY BE AS LOW AS 17 YEARS OLD!

THE HUGE SEA CHANGE LIES AHEAD

- ABILITY TO OPERATE DRONES BEYOND LINE OF SIGHT

NO BLOS NO PIZZA

- ITS ALL ABOUT COLLISION AVOIDANCE

Remember That Problem…How Safe Is The Man In The Manned Aircraft?

- First Person View (FPV) Technology Rapidly Becoming Way To Fly, But Not OK'd by FAA
- Collision Avoidance Systems Exist, But Not OK'd by FAA
- Integration Into The National Airspace Means Finally Tackling That "How Safe is the Man" Standard

Congress Said Git-Er-Done by 2015…Not Gonna Happen

TRIVIA QUIZ

- HOW MUCH LIABILITY INSURANCE IS A DRONE REQUIRED TO CARRY?
  - $10 MILLION
  - $5 MILLION
  - $1 MILLION
  - $50K
  - NONE

MAJOR CHALLENGES REMAIN

- COLLISION AVOIDANCE TECHNOLOGY
- NAS ARCHITECTURE
- ACCOUNTABILITY
  - Insurance Requirements
  - Safest Route Planning
- TRANSPARENCY
  - Registration
- PRIVACY
  - Operational Constraints
  - Data Constraints

NO WAITING…
THE CALIFORNIA GREAT DRONE DEBATE

READY TO IMPROVE IRRIGATION AND NUTRIENT MANAGEMENT

IF YOU DON'T LIKE IT UNMANNED

- THERE IS ALSO SOMETHING FOR YOU

THANKS FOR YOUR ATTENTION